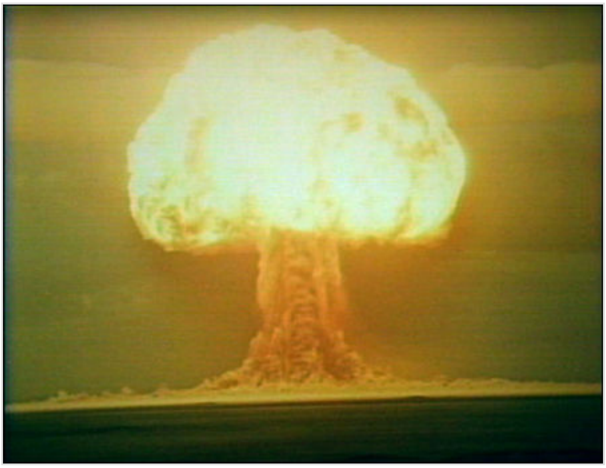
ВикипедиЯ

RDS-6s

Material from Wikipedia - the free encyclopedia

RDS-6s	
Type	H-bomb
Service history	
In service	USSR



Fire cloud of RDS-6s explosion

RDS-6s - the first Soviet hydrogen bomb . The world's first nuclear explosive device using thermonuclear energy, manufactured in the form of a bomb suitable for practical military use [1] . According to foreign classification, it is classified not as a hydrogen bomb, but as an atomic bomb with thermonuclear enhancement (boosting). Obviously, the idea of boosting is a close relative of the idea of a layered nuclear charge with thermonuclear enhancement. So, for example, in the UK, both types of such charges were called boosted nuclear charges (see Orange Herald) , only in one case - core boost charges, and in the other case - tamper boost charges [2] .

It was not a thermonuclear charge in the modern sense. The fact is that a charge can be considered thermonuclear if more than half of the energy during its explosion is released due to thermonuclear reactions of fusion of nuclei of hydrogen isotopes - deuterium and tritium, and not due to fission reactions of uranium or plutonium nuclei. From this point of view, the "Sakharov layer" was an atomic charge with the so-called thermonuclear enhancement, which produced a flow of neutrons that contributed to the fission of uranium-238 nuclei. This made it possible to increase the charge power to 400 kilotons [3] .

Developed by a group of scientists led by A. D. Sakharov and Yu. B. Khariton . Work on creating a bomb began in 1950. Tested at the Semipalatinsk test site on August 12, 1953 .

Content

Design
Development
Trial
Meaning
Notes
Links

Construction

RDS-6s is a single-stage nuclear bomb with implosion - type thermonuclear enhancement. The declared power could reach 500 kt, during tests a power of 400 kt was obtained [4] Efficiency - 15-20%. Synthesis accounted for 15-20% of the total energy release.

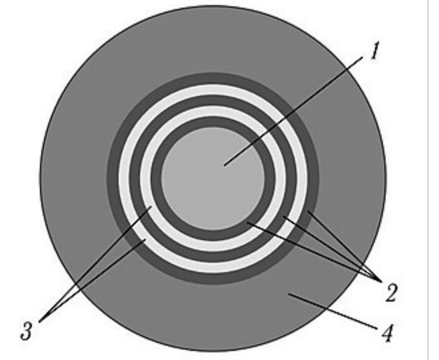
The tested RDS-6s was considered an experimental model. Calculations showed that it was possible to obtain a power of 700 kilotons or more, using more tritium and uranium-235 in the developed design [5] .

Although the RDS-6s was claimed to be the world's first hydrogen bomb suitable for practical military use, it contained a significant amount of tritium , and therefore the cost of the charge was very high, and it itself had a relatively limited survivability in terms of shelf life (about six months), from -why the possibility of its use in the nuclear arsenal of the USSR was practically excluded [4] . One RDS-6s bomb required 1200 g of tritium. To obtain such an amount of isotope, it took almost a year of operation of the AI nuclear reactor complex with a planned annual production volume of 1500 g of tritium, and expensive work at the 817 plant to separate tritium from irradiated blocks [6] . Therefore, the bomb was later upgraded into its tritium-free version - the RDS-27 bomb . In its charge, instead of the very expensive, difficult to obtain and subject to radioactive decay tritium, only stable lithium-6 deuteride was used . The explosion power of the RDS-27 created in this way during testing was 250 kt (November 6, 1955).

A variant of the design in the USSR was proposed by A.D. Sakharov, as a heterogeneous structure of alternating layers of light matter (deuterium, tritium and their chemical compounds) and heavy (^{238}U), which he called a “puff”.

Previously, similar ideas were proposed in the USA in 1946 by E. Teller . This information was transmitted by agents collaborating with Soviet intelligence, and in particular by K. Fuchs. The Alarm Clock was a layered thermonuclear bomb crimped with explosives. In "Alarm Clock" only a small part of the energy release was obtained in thermonuclear reactions. Similar to Project Booster, the thermonuclear reactions in Alarm Clock basically boosted the fission process. This device could require 2-3 times more powerful initiating explosion than the Fat Man device provided, i.e. 40-60 kt. Theoretical work on the Alarm Clock continued from the moment the idea appeared in 1946 until the end of 1947. In September 1947, Teller proposed using lithium-6 deuteride as a thermonuclear fuel in the Alarm Clock. The use of lithium deuteride greatly simplified the problem associated with the production of tritium, which at that time limited the development of thermonuclear weapons. However, it required the use of material enriched in the Li-6 isotope and did not solve ignition problems. Computer calculations of the original Alarm Clock configuration were completed in 1953-1954. and showed that a device with a large energy release in this form would be inoperative. The most successful calculations of that time showed that to obtain an energy release of 10 Mt, the number of explosives in the device had to be from 40 tons to 100 tons [2] (http://elib.biblioatom.ru/text/andryushin_reshayuschiy-shag-k-miru_2010/go,27/) .

Therefore, the creation of such a charge was abandoned in the United States, recognizing the idea of a “puff” as a dead end. One of the factors that influenced this was the limited possibilities for scaling the energy release, another was a fundamental factor - the possible development of instabilities during the implosion of a layered system at the initial stage of its combustion [3] (https://ufn.ru/ufn11/ufn11_4/Russian/r114i.pdf) .



Scheme RDS-6s

In the fall of 1948, A.D. Sakharov, having first become acquainted with the circuit and structure of the RDS-1 atomic bomb, independently of Edward Teller, came up with the idea of a heterogeneous circuit with alternating layers of deuterium and U-238 (“puff”) [4] (http://www.biblioatom.ru/evolution/dostizheniya/pervaya-vodorodnaya-bomba/) . To increase the proportion of “burnt” deuterium, Sakharov proposed surrounding the deuterium with a shell of ordinary natural uranium, which was supposed to slow down the expansion, and most importantly, significantly increase the concentration, density and temperature of deuterium. At the temperature that arises after the explosion of an atomic bomb-fuse, the surrounding matter is almost completely ionized. At the same time, the uranium shell, the density of which is 12 times greater than the density of conventional explosives, increases the concentration of deuterium by more than 10 times, and therefore increases the rate of thermonuclear reaction. Sakharov’s collaborators called this method of increasing the thermonuclear reaction in a puff pastry “saccharization.” An increase in the rate of the dd reaction leads to a noticeable formation of tritium, which immediately enters into a thermonuclear reaction with deuterium, with a cross section 100 times greater than the cross section of the dd reaction and a 5 times greater energy release. Under the influence of the resulting fast neutrons, which appear in the dt reaction, the nuclei of the uranium shell fission well and significantly increase the power of the explosion. That is why natural uranium was chosen as the shell, rather than any other heavy substance (for example, lead).

The exact number of layers and their dimensions are classified. Presumably, RDS-6 contained at least two layers of light elements surrounded by layers of uranium-238. At the center of RDS-6, the so-called main charge (central core), an atomic fission charge made from uranium-235, was used, the exact weight and dimensions of which are also classified [7] . From declassified data it became known that the explosion power of the main charge was about 50 kt [5] (http://elib.biblioatom.ru/text/atomny-proekt-sssr_t3_kn2_2009/go,22/) . Ritus V.I. writes [8] that tritium was used not only in the first, but also in the second light layer, due to which it was possible to achieve a release of energy greater than expected. The main (central) charge is spherically symmetrical, originally planned to be composite, made of plutonium (inner layer) and uranium-235 (outer layer). Fearing a premature nuclear explosion, even before achieving the required degree of compression, a number of Soviet bomb scientists proposed making the main (central) charge not a composite charge, but only from uranium –235.

The device was a system of alternating layers of thermonuclear material (lithium deuteride-tritide and lithium deuteride) and uranium with different contents of the U-235 isotope and ensured their gas-dynamic implosion [6] (https://ufn.ru/ufn11/ufn11_4/Russian/r114i.pdf). Directly adjacent to the main (central) charge is a layer of lithium-6 deuteride-tritide, then natural uranium (probably with an increased content of the U-235 isotope), then again a layer of lithium-6 deuteride-tritide, then natural uranium. The exact mass-dimensional data and composition of the RDS-6s materials will be secret throughout the duration of the treaties on the non-proliferation of nuclear weapons , that is, presumably always.

Initially, it was planned to equip the R-7 ICBM with a thermonuclear (or, according to foreign classifications, boosted nuclear) charge of the RDS-6s type. At the same time, it was necessary to exclude the use of lithium deuteride-tritide in this charge due to the scarcity of tritium and a significant deterioration in the operational characteristics of the charge in the case of using tritium. It was also necessary to increase the energy release of the charge.

Estimates have shown that a charge of the RDS-6s type with the required power will have excessively large dimensions and weight. Therefore, it was decided to investigate the possibility of increasing the power of the RDS-6s charge in its tritium-free version through the use of a significant mass of fissile materials. This charge was given the designation RDS-6sD [2] .

V.I. Ritus writes [9] that after the successful testing of RDS-6c, A.D. Sakharov, in order to triple the concentration of ionization-compressed deuterium, proposed using gaseous molecular deuterium D2, compressed to 150 atmospheres, instead of Li6D. It was planned to place small pieces or thin plates of lithium-6 in a layer of gaseous deuterium, so that when irradiated with neutrons during the explosion of the fuse, tritium would be obtained. Tritium nuclei, due to their long range, will fly out of thin pieces of lithium-6 and, entering the atmosphere of heated deuterium, will enter into a thermonuclear reaction with it (see document No. 40 in [10])). This version of the “product” proposed by A.D. Sakharov under the name RDS-6sD was approved by the Council of Ministers for development and testing in 1954. The decree of the USSR government, as A.D. Sakharov wrote in his “Memoirs,” “obliged rocket scientists to develop under this charge is an intercontinental ballistic missile." However, detailed calculations carried out showed that the energy release of several different proposed versions of the RDS-6SD turned out to be lower than expected. The “exotic” product did not live up to expectations and after numerous and dramatic discussions with high authorities (V. A. Malyshev, B. L. Vannikov, A. P. Zavenyagin, I. V. Kurchatov), plans for its development were canceled. During development, it gradually became clear that by using the physical circuit of the RDS-6s charge, the problem of creating a highly efficient thermonuclear charge of the required power could not be solved [2] [9] .

Development

Since 1942, I.V. Kurchatov received intelligence information about ongoing research in the United States into the possibility of creating a “superbomb” .

Of the Soviet scientists, Ya. I. Frenkel was the first to draw attention to the fact that "it seems interesting to use the high - billionth - temperatures that develop during the explosion of an atomic bomb to carry out fusion reactions (for example, the formation of helium from hydrogen), which are the source of energy for stars and which could further increase the energy released during the explosion of the main substance." In 1945, he outlined this idea in a memo addressed to Kurchatov [11] .

Kurchatov instructed Yu. B. Khariton, together with I. I. Gurevich , Ya. B. Zeldovich and I. Ya. Pomeranchuk, to consider the possibility of releasing the energy of light elements. They reported their thoughts on this problem on December 17, 1945 at a meeting of the Technical Council of the Special Committee under the Council of People's Commissars of the USSR . The speaker was Ya. B. Zeldovich. His report confirmed the fundamental possibility of exciting nuclear detonation in a cylinder with deuterium [11] .

On September 28, 1947, in London, K. Fuchs informed Soviet intelligence officer A. S. Feklisov that the United States was actively working on the creation of a hydrogen bomb and described some of the design features of this bomb and the principle of its operation. On March 13, 1948, the second meeting of K. Fuchs with A. S. Feklisov took place, at which K. Fuchs transmitted experimental data that contained very important information about the cross sections of some nuclear reactions necessary for calculations of the possibility of thermonuclear detonation. On April 20, 1948, the leadership of the USSR MGB sent a Russian translation of K. Fuchs' materials to I. V. Stalin , V. M. Molotov , L. P. Beria [11] .

On June 10, 1948, Resolution of the Council of Ministers of the USSR No. 1989-733 "On supplementing the work plan of KB-11" was adopted, which set the task of testing the possibility of creating a hydrogen bomb, which was assigned the index RDS-6. On the same day, Resolution No. 1990-774 of the Council of Ministers of the USSR was adopted, ordering the creation of a special theoretical group under the leadership of Corresponding Member of the USSR Academy of Sciences I. E. Tamm [11] .

In September-October 1948, A.D. Sakharov, who was a member of I.E. Tamm's group, thought about an alternative solution to the problem and began to consider the possibility of implementing a combined bomb in which deuterium is used in a mixture with uranium-238 in the form of alternating layers. This scheme is called "puff paste" [11] . After this, the development of the bomb went in two directions: the "puff" (RDS-6s), which meant an atomic charge surrounded by several layers of light and heavy elements, and the "pipe" (RDS-6t), in which the plutonium bomb was immersed in liquid deuterium . The US has developed similar schemes. For example, the "Alarm clock" scheme, which was put forward by Edward Teller , was an analogue of Sakharov's puff pastry, but it was never implemented in practice. But the "Pipe" scheme, which scientists worked on for so long, turned out to be a dead-end idea [12] . After testing the first Soviet atomic bomb RDS-1, the main efforts were concentrated on the Sloika variant [13] .

In 1949 , after the successful test of the first Soviet atomic bomb , the Americans accelerated the program to build up their strategic nuclear forces . On January 31, 1950, US President Henry Truman issued a statement declaring that he had given instructions "... to continue work on all types of atomic weapons, including the so-called hydrogen or superbomb" [11] .

The development of thermonuclear weapons became an increasingly priority for the Soviet Union. On February 26, 1950, the Council of Ministers of the USSR adopted Resolution No. 827-303 "On work to create the RDS-6," which set the production date for the first copy of the RDS-6s product as 1954. Yu. B. Khariton was appointed scientific director of the development, and I. E. Tamm and Ya. B. Zeldovich were his deputies [11] .

In the spring of 1950, nuclear physicists I. Tamm , A. Sakharov and Yu. Romanov moved to the “facility” in KB-11 (Sarov), where they began intensive work on the creation of a hydrogen bomb [14] .

Calculations for RDS-6s/"Sloika" were carried out under the guidance of A. Tikhonov and K. Semendyaev on the "Strela" computer . Since the reliability of the first generation computers was low, each calculation was carried out twice, and sometimes a control third calculation was also carried out. At the same time, certain charge design schemes were rejected and the initial estimates were significantly corrected [15] .

The State Commission, chaired by I.V. Kurchatov, having analyzed the results of the dress rehearsal and reporting its considerations to the government, decided to test the first hydrogen bomb on August 12, 1953 at 7:30 a.m. local time [12] .

Test

The operation to assemble the charge was carried out by N. L. Dukhov , D. A. Fishman , N. A. Terletsky under the leadership of Yu. B. Khariton and in the presence of I. V. Kurchatov [14] . The preparation of the automation system was carried out by V.I. Zhuchikhin and G.A. Tsyrkov . A.D. Zakharenkov and E.A. Negin took part in the work . Equipping the charge with detonator capsules after lifting it onto the tower was carried out by A.D. Zakharenkov and G.P. Lominsky under the leadership of K.I. Shchelkin and in the presence of A.P. Zavenyagin [14] .

At the Semipalatinsk test site , meanwhile, intensive preparation was underway for the experimental site, on which various buildings, recording equipment, military equipment and other objects were located. Prepared:

- 1300 measuring, recording and filming instruments;
- 1700 different indicators;
- 16 aircraft;
- 7 tanks;
- 17 guns and mortars.

In total, there were 190 different structures on the field [14] . In this test, vacuum intakes of radiochemical samples were used for the first time, which were automatically opened under the influence of a shock wave . In total, 500 different measuring, recording and filming devices installed in underground casemates and durable ground structures were prepared for testing the RDS-6s. Aviation technical support for the tests - measuring the pressure of the shock wave on an aircraft in the air at the time of the explosion of the product, taking air samples from a radioactive cloud , aerial photography of the area, etc. - was carried out by a special flight unit. The bomb was detonated remotely by sending a signal from a remote control located in the bunker [12] .

It was decided to carry out an explosion on a steel tower 40 m high, the charge was located at a height of 30 m. The radioactive soil from previous tests was removed to a safe distance, special structures were built in their places on the old foundations, a bunker was built 5 m from the tower for the installation of equipment developed at the Institute of Chemical Physics of the USSR Academy of Sciences that records thermonuclear processes.

The signal for detonation was given at 7:30 am on August 12, 1953 [12] . The horizon was illuminated by a bright flash that blinded the eyes even through dark glasses. The power of the explosion was 400 kt , which was 20 times higher than the energy release of the first atomic bomb. Soviet physicist Yu. Khariton, having analyzed the test, stated that fusion accounts for about 15-20%, the rest of the energy was released due to the splitting of U-238 by fast neutrons [12] . The RDS-6s bomb was the first to use “dry” thermonuclear fuel , which was a serious technological breakthrough [14] .

According to the test results, brick buildings within a radius of 4 km were completely destroyed; at a distance of 1 km, a railway bridge with 100-ton spans was thrown back 200 m [16] .

Radiation level in the cloud at an altitude of 3000 m after 20 minutes: 5.4 R/h, at an altitude of 4000-5000 m after 1 hour 04 minutes: 9 R/h, at an altitude of 8000 m after 33 minutes: 360 R/h, at at an altitude of 10,000 m after 45 minutes: 144 R/h, the length of the pollution strip with a dose of more than 1 R after 30 minutes was 400 km, width 40-60 km, the next day a strip 480 km long, 60 km wide had 0.01 R/ h. The radioactive cloud, 3 hours after the explosion, measuring 100 by 200 km, was divided into 3 parts, the first moved towards Lake Baikal , here the radiation dose did not exceed 0.5 R, the middle part went towards Omsk , the maximum dose was no more than 0 ,2 R, the lowest part of the cloud went in a small circle around the Altai Territory in the direction of Omsk , Karaganda and so on. The maximum dose in this case did not exceed 0.01 R [17] .

Meaning

The test of the RDS-6s showed that the USSR was the first in the world to create a compact (the bomb was placed in a Tu-16 bomber) thermonuclear product of enormous destructive power. By that time, the United States “had available” a test of a thermonuclear device the size of a three-story house. The Soviet Union stated that it also possesses thermonuclear weapons, but unlike the United States, its bomb is completely ready and can be delivered by a strategic bomber to enemy territory. American experts disputed this statement, based on the fact that the Soviet bomb was not a “real” hydrogen bomb, since it was not designed according to the radiation implosion scheme (Teller-Ulam scheme) [18] . However, until 1954, the United States did not have transportable thermonuclear bombs in its arsenal.

After successful testing, many designers, researchers and production workers were awarded orders and medals [14] . The main ideologist of the first hydrogen bomb, A.D. Sakharov, immediately became an academician of the USSR Academy of Sciences . He was awarded the title of Hero of Socialist Labor and laureate of the Stalin Prize . The title of Hero of Socialist Labor for the second time was awarded to Yu. B. Khariton , K. I. Shchelkin , Ya. B. Zeldovich and N. L. Dukhov . The title of Hero of Socialist Labor was also awarded to M. V. Keldysh , who provided mathematical support for the work on creating a hydrogen bomb.

The Sloika scheme, however, did not have the prospect of scaling the explosion power beyond a megaton. Tests of " Evie Mike " in the USA in November 1952 proved that the power of a hydrogen explosion produced according to a certain scheme can exceed several megatons. On March 1, 1954, during the Castle Bravo tests , the United States exploded a bomb assembled according to the Teller-Ulam two-stage design, and received an explosion yield of 15 megatons. The USSR managed to unravel the secret of the scheme by 1954 and test the RDS-37 megaton bomb , created according to the Teller-Ulam scheme, on November 22, 1955 at the Semipalatinsk test site. As in RDS-6s, lithium-6 deuteride was used as thermonuclear fuel [19] .

Notes

In the Memorandum of V. A. Malyshev, B. L. Vannikov and A. P. Zavenyagin to G. M. Malenkov on the readiness for testing of the model of the hydrogen bomb RDS-6s and the atomic bombs RDS-4 and RDS-5 dated July 18, 1953 . It is written that the RDS-6s product, like other previously tested atomic bombs, has a certain probability of an inferior (weakened in power) explosion, which depends on the intrinsic radioactivity of plutonium and uranium-235 and the possibility of starting a nuclear chain reaction before the charge is completely compressed [7] (http://elib.biblioatom.ru/text/atomny-proekt-sssr_t3_kn2_2009/go,33/) . This may indicate that perhaps the central charge was composite and consisted of plutonium (inner layer) and uranium-235 (outer layer).

1. Thermonuclear bomb and lithium deuteride (http://trv-science.ru/2009/11/24/termoyadernaya-bomba-i-dejterid-litiya/) . *trv-science.ru* . Trinity option - Science (November 24, 2009). Access date: August 10, 2015. Archived (https://web.archive.org/web/20121106120423/http://trv-science.ru/2009/11/24/termoyadernaya-bomba-i-dejterid-litiya/) November 6, 2012. (https://web.archive.org/web/20121106120423/http://trv-science.ru/2009/11/24/termoyadernaya-bomba-i-dejterid-litiya/)
2. *Andryushin I. A., Chernyshev A. K., Yudin Yu. A.* Taming the core. Pages of the history of nuclear weapons and nuclear infrastructure of the USSR (https://www.atomic-energy.ru/files/books/Ukroschenie%20yadra%20(2005).pdf) . — Sarov; Saransk: Type. “Red October”, 2003. - 116 p. Date accessed: September 4, 2020.Archived (https://web.archive.org/web/20200822233529/https://www.atomic-energy.ru/files/books/Ukroschenie%20yadra%20(2005).pdf) August 22, 2020. (https://web.archive.org/web/20200822233529/https://www.atomic-energy.ru/files/books/Ukroschenie%20yadra%20(2005).pdf)
3. Yuri Trutnev: “The creation of nuclear weapons is a special creativity (https://ria.ru/20171122/1509304656.html) . ” *ria.ru.* RIA Novosti (November 22, 2017). Date accessed: December 15, 2022. Archived (https://web.archive.org/web/20221215114659/https://ria.ru/20171122/1509304656.html) December 15, 2022. (https://web.archive.org/web/20221215114659/https://ria.ru/20171122/1509304656.html)
4. Source (http://elibrary.lt/resursai/Uzsienio%20leidiniai/Uspechi_Fiz_Nauk/1996/02/r962f.pdf) . Date accessed: September 25, 2020.Archived (https://web.archive.org/web/20211023025817/http://elibrary.lt/resursai/Uzsienio%20leidiniai/Uspechi_Fiz_Nauk/1996/02/r962f.pdf) October 23, 2021. (https://web.archive.org/web/20211023025817/http://elibrary.lt/resursai/Uzsienio%20leidiniai/Uspechi_Fiz_Nauk/1996/02/r962f.pdf)
5. USSR Atomic Project. Documents and materials / Under the general editorship of L. D. Ryabev . - Vol. III: Hydrogen bomb (1945-1956). - Book 1. - M .: Nauka, Fizmatlit, 2008. - P. 626.
6. Evolution of the industry: History of the main systems of the industry: History of reactors: AI reactor - History of Rosatom (http://www.biblioatom.ru/evolution/istoriya-osnovnyh-sistem/istoriya-reactorov/ai/) . Date accessed: September 25, 2020. Archived (https://web.archive.org/web/20201029170950/http://www.biblioatom.ru/evolution/istoriya-osnovnyh-sistem/istoriya-reactorov/ai/) October 29, 2020. (https://web.archive.org/web/20201029170950/http://www.biblioatom.ru/evolution/istoriya-osnovnyh-sistem/istoriya-reactorov/ai/)
7. Ryabev L I (General ed.). USSR atomic project. Documents and materials. Under the general editorship of L. D. Ryabev. Volume III. Hydrogen bomb 1945-1956. Book 1. (M.: Nauka, Fizmatlit, 2008 Page 689
8. V.I. Ritus, “V. L. Ginzburg and the Atomic Project”, UFN, 187:4 (2017), 444–449; Phys. Usp., 60:4 (2017), 413–418 (https://www.mathnet.ru/links/fa1349a926a737f5494ec7f38a6e24b6/ufn5853.pdf) . *www.mathnet.ru* . Date accessed: December 4, 2020.

9. *V. I. Ritus.* Tamm-Sakharov group in work on the first hydrogen bomb (https://www.mathnet.ru/php/getFT.phtml?jrnid=ufn&paperid=4951&what=fullt&option_lang=rus) (Russian) // UFN. - 2014. -T. 184,No. 9. —pp. 975–983.
10. Ryabev L I (General ed.), Goncharov G. L. (Responsible author) Atomic project of the USSR. Documents and materials. T. 3. Hydrogen bomb 1945 1956 Book. 2 (M.: Nauka, Fizmatlit, 2009
11. I. Nikitchuk. Thermonuclear breakthrough (https://www.ivkprf.ru/novosti/novosti-ck-kprf/ltermoyadernyj-proryvr-statya-ii-nikitchuka-v-gazete-lpravdar-k-60-letiyu-sozdaniya-vodorodnoj-bomby-v-sssr/) . Access date: December 30, 2019.Archived (https://web.archive.org/web/20191230224903/https://www.ivkprf.ru/novosti/novosti-ck-kprf/ltermoyadernyj-proryvr-statya-ii-nikitchuka-v-gazete-lpravdar-k-60-letiyu-sozdaniya-vodorodnoj-bomby-v-sssr/)December 30, 2019. (https://web.archive.org/web/20191230224903/https://www.ivkprf.ru/novosti/novosti-ck-kprf/ltermoyadernyj-proryvr-statya-ii-nikitchuka-v-gazete-lpravdar-k-60-letiyu-sozdaniya-vodorodnoj-bomby-v-sssr/)
12. About the test of the first hydrogen bomb (http://sarov.info/index.php?ch=europaplus&id=11544&view=article&prevview=arc&year=2008&month=8) . Access date: February 12, 2010.Archived (https://web.archive.org/web/20140826113338/http://sarov.info/index.php?ch=europaplus&id=11544&view=article&prevview=arc&year=2008&month=8)August 26, 2014. (https://web.archive.org/web/20140826113338/http://sarov.info/index.php?ch=europaplus&id=11544&view=article&prevview=arc&year=2008&month=8)
13. Modern aviation of Russia (http://aviaros.narod.ru/rds-6.htm) . Access date: February 12, 2010. Archived (https://web.archive.org/web/20100123072920/http://aviaros.narod.ru/rds-6.htm) January 23, 2010. (https://web.archive.org/web/20100123072920/http://aviaros.narod.ru/rds-6.htm)
14. Testing of the first thermonuclear weapons (https://web.archive.org/web/20101231080025/http://wsyachina.narod.ru/history/nuclear_testing_5.html) . Access date: February 12, 2010. Archived fromthe original (http://www.wsyachina.narod.ru/history/nuclear_testing_5.html)on December 31, 2010. (http://www.wsyachina.narod.ru/history/nuclear_testing_5.html)
15. Atomic project (http://letopis.msu.ru/content/es-atomnyy-proekt) . Retrieved November 26, 2021. Archived (https://web.archive.org/web/20211126101315/http://letopis.msu.ru/content/es-atomnyy-proekt) November 26, 2021. (https://web.archive.org/web/20211126101315/http://letopis.msu.ru/content/es-atomnyy-proekt)
16. Test of the RDS-6S hydrogen bomb, 1953. (https://www.youtube.com/watch?v=XpD-TMUJ4EU&feature=player_embedded#!) Archived copy (https://web.archive.org/web/20160416055556/https://www.youtube.com/watch?v=XpD-TMUJ4EU&feature=player_embedded#!) from April 16, 2016 on the Wayback Machine - YouTube (video)
17. Tests of the first thermonuclear charges RDS-6s and RDS-37 > History > (http://wsyachina.narod.ru/history/nuclear_testing_5.html) [1] (https://web.archive.org/web/20101231080025/http://wsyachina.narod.ru/history/nuclear_testing_5.html)Archived copy (https://web.archive.org/web/20101231080025/http://wsyachina.narod.ru/history/nuclear_testing_5.html) dated December 31, 2010 on the Wayback Machine // “All sorts of things” - Library of various articles
18. The Soviet Nuclear Weapons Program (http://nuclearweaponarchive.org/Russia/Sovwpnprog.html)
19. Atomicforum:Soviet/Russian Nuclear Testing Summary (https://web.archive.org/web/20080317191454/http://www.atomicforum.org/russia/russiantesting.html) (collected on web.archive.org) (English)

Links

- Modern aviation of Russia (http://aviaros.narod.ru/rds-6.htm) .
- To the 55th anniversary of the test of the first domestic thermonuclear bomb RDS-6s (http://sarov.info/index.php?ch=europaplus&id=11544&view=article&prevview=arc&year=2008&month=8) .
- Testing of the first hydrogen bombs RDS-6 and RDS-37 (https://web.archive.org/web/20101231080025/http://wsyachina.narod.ru/history/nuclear_testing_5.html) .
- Joe_4 .

- Newsreel of the detonation of an RDS-6s charge (https://www.youtube.com/watch?v=D0rJvaejMn8&ab_channel=ФИЗИКАВЗРЫВА)

Источник — https://ru.wikipedia.org/w/index.php?title=РДС-6с&oldid=136312872